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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Docket No. 0390112

Examiner Helane Myers

In re application:
PETER J. JESSUP ET AL.

PATENT

Serial No. 08/409,074
Filed: March 22, 1995

GASOLINE FUEL

Assistant Commissioner For Patents
Washington, D. C. 20231

Dear Sir:

AFFIDAVIT UNDER 37 CFR 1.132

I, Peter J. Jessup, being duly sworn, depose and say that:

1. I am by profession a Research Chemist, having earned the degree of Bachelor of Science in Chemistry in 1972 and the degree of Doctor of Philosophy in Chemistry in 1976, both from the Latrobe University, Melbourne, Australia;

2. I engaged in Post-Doctorate Research at the University of California at Irvine from 1976 to 1977 in the scientific field of natural product synthesis;

3. I have been employed by the Union Oil Company of California from 1978 to 1981 and, after being briefly employed with Exxon in 1981-1982, from 1982 to the present date. My current title is Principal Scientist and my professional responsibility is in the scientific field pertaining to research related to fuels, lubricant additives, fuel additives, synthetic chemistry, and fuel combustion chemistry, particularly as applied to diesel engines or internal combustion engines for motor vehicles;

4. I currently am the patentee or copatentee of 26 United States patents, most of which patents relate to automotive engines, fuels, and lubricants;

5. I am one of the applicants of the above-identified patent application, i.e., Serial No. 08/409,074 filed March 22, 1995 entitled "Gasoline Fuel," and all references hereinafter to "our patent application" and "our specification" are to said application and its specification, respectively.

6. Prior to the end of June 1990, Dr. Michael C. Croudace and I had run the experiment described in Example 1 of our patent application and had developed the equations pertaining thereto (See our specification on page 11.), which equations establish, among other things, that reducing the T50 of an unleaded gasoline would, all other things being equal, reduce both CO and HC tailpipe emissions when combusted in an automobile with a catalytic converter. (See our specification on page 11, line 28 to page 12, line 26.)

7. On July 17, 1990 I attended a meeting at Unocal's research facility in Brea, California at which Jonathan Haines, a representative from Toyota Technical Center, USA, Inc., distributed a two-page document (attached herewith as Attachment T1) showing data pertaining to fuels for a Toyota experiment. At present, I can no longer remember if Mr. Haines told me if the Toyota experiment relating to the 10 fuels shown in Attachment T1 was one which had been done by Toyota, was then currently being done by Toyota, or then still in the planning stage.

8. At the meeting I made handwritten notes of some of Mr. Haines' statements on my copy of Attachment T1, which handwritten notes can be seen on said Attachment T1. My notes

indicate, among other things, that Mr. Haines' said that Toyota had data relating T50 to exhaust emissions, i.e., that increases in T50 caused increases in emissions, that Toyota wanted tight control on T50 for reformulated gasolines, and that Toyota was recommending an 85 - 100° C. (185 - 212° F.) T50 range. My notes also indicate that Toyota allegedly had data showing a 50% change in emissions by changing T50.

9. Subsequently, I received in the mail from Mr. Haines a 19 page document entitled "Effect of Gasoline Property on Exhaust Emissions and Driveability" by Toyota Motor Corporation, dated October, 1990 (a copy attached herewith as Attachment T2, with handwritten page numbers added in lower right hand corner). Accompanying the document was a memo from Mr. Haines dated October 28, 1990, a copy of said memo being attached herewith as Attachment T3.

10. Upon review of this Attachment T2, I found no evidence therein that decreasing T50 yields reductions in HC and CO emissions. Although the bar chart on page 7 of Attachment T2 allegedly relates T50 to the emissions produced from three fuels A, B, and C, the data in the document do not support this conclusion. According to the figure on said page 7, Fuel A yielded more HC and CO than Fuel B, which in turn yielded more than Fuel C. From this information, it appeared to me that Toyota had assumed that T50 was the cause of this phenomenon because, as shown on page 8 of Attachment T2, the T50 of fuel A was higher than Fuel B, which in turn was higher than the T50 of Fuel C. But the same could be said for density, and for IBP, and for T10, and for aromatics, and for octane. Any one, or some combination thereof, or some other gasoline property or properties, or yet other factors, could have been responsible for the emissions results of Fuels A, B, and C.

11. In sum, I found Toyota's apparent reasoning for concluding that decreasing T50 decreases HC and CO emissions to be seriously flawed and scientifically invalid, the conclusion being unsupported from the data and other information on pages 7 and 8. Essentially, from the information presented on pages 7 and 8 of Attachment T2, what Toyota did was prepare three fuels of widely varying properties and then, for unknown reasons, arbitrarily ascribe the emission results as a function of one of the properties.

12. Thus, while Toyota's conclusion that decreasing T50 decreases HC and CO emissions agreed with my own earlier finding, I could not, and did not, accept the work reflected in Attachment T2 as confirmation of my earlier finding.

FURTHER AFFIANT SAYS NOT.

Peter J. Jessup

Peter J. Jessup

Subscribed and sworn to me this 10th day of July, 1995.

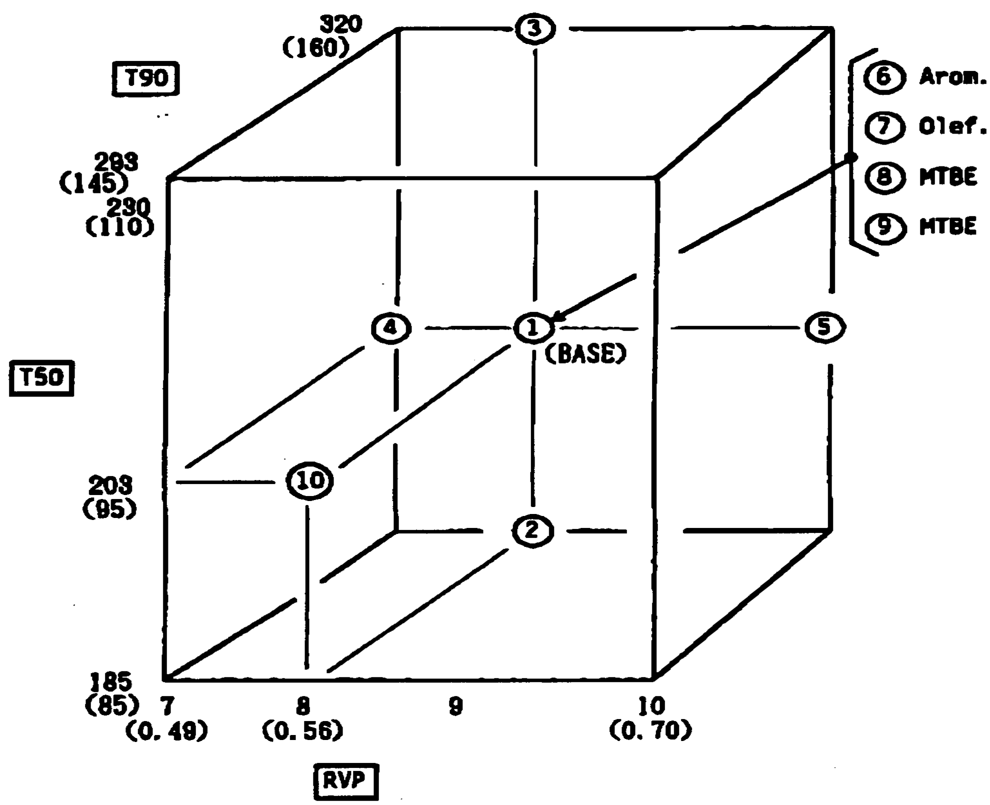
Pat Lance

Notary public for and in
State of California
County of Orange
My Commission Expires FEBRUARY 1, 1997

PAT LANCE
COMM. #981656
NOTARY PUBLIC - CALIFORNIA
ORANGE COUNTY
My Comm. Expires Feb. 1, 1997

$T_{50}\uparrow \equiv$ emissions $\uparrow$

From Toyota
7-17-90



Test Gasoline Matrix

ATTACHMENT T1

TEST FUELS FOR REFORMULATED GASOLINE STUDY ~ target specs.

Fuel No.	RON	(MON)	RVP psi	T50 °F	T90 °F	Arom. vol.%	Olef. vol.%	MTBE vol.%	Comments
1	97	87	8.0 (0.56)	203 (95)	320 (160)	30	12	0	Base Case
2	97	87	8.0	185 (85)	320	30	12	0	T50 Reduction
3	97	87	8.0	239 (110)	320	30	12	0	T50 Increase
4	97	87	7.0 (0.49)	203	320	30	12	0	RVP Reduction
5	97	87	10.0 (0.70)	203	320	30	12	0	RVP Increase
6	97	87	8.0	203	320	15	12	0	Arom. Contents Reduction
7	97	87	8.0	203	320	30	0	0	Olef. Contents Reduction
8	97	87	8.0	203	320	30	12	7	MTBE Blend (Medium Conc.)
9	97	87	8.0	203	320	30	12	15	MTBE Blend (Maximum Conc.)
10	97	87	8.0	203	293 (145)	30	12	0	T90 Reduction
			x	X	x	x	x	x	

$\boxed{AKI = 92}$

driveability
FTP emissions

Toyota wants tight control of T_{50} in reformulated gasolines.

x = variables.

T_{50} 85→100 °C
~ pushing @ CARB

Saw 50% change in emissions by changing T_{50}.

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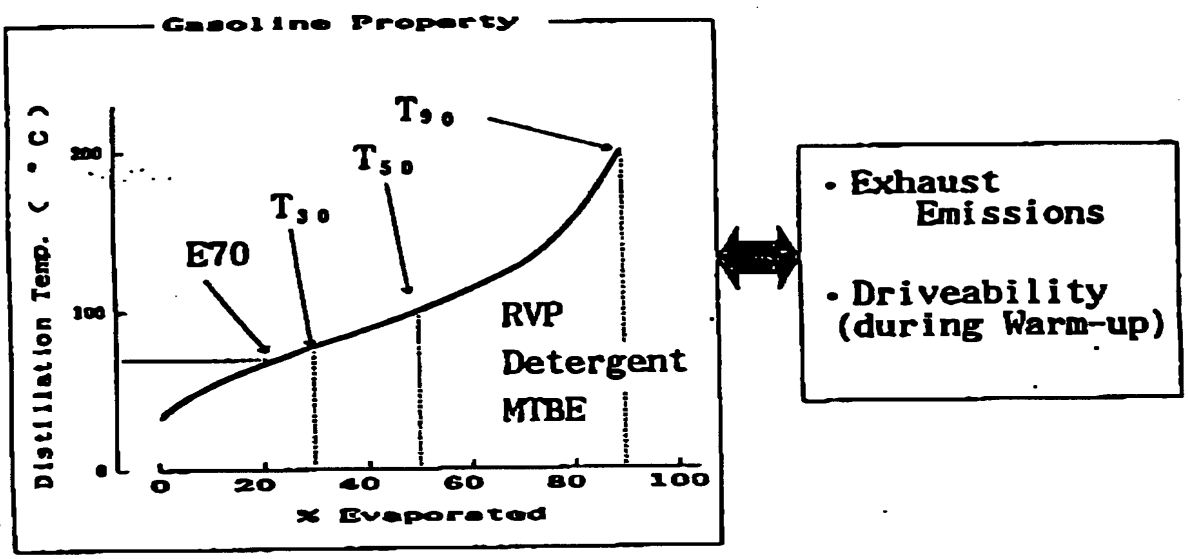
EFFECT OF GASOLINE PROPERTY ON EXHAUST EMISSIONS AND DRIVEABILITY

TOYOTA MOTOR CORPORATION
OCTOBER, 1990

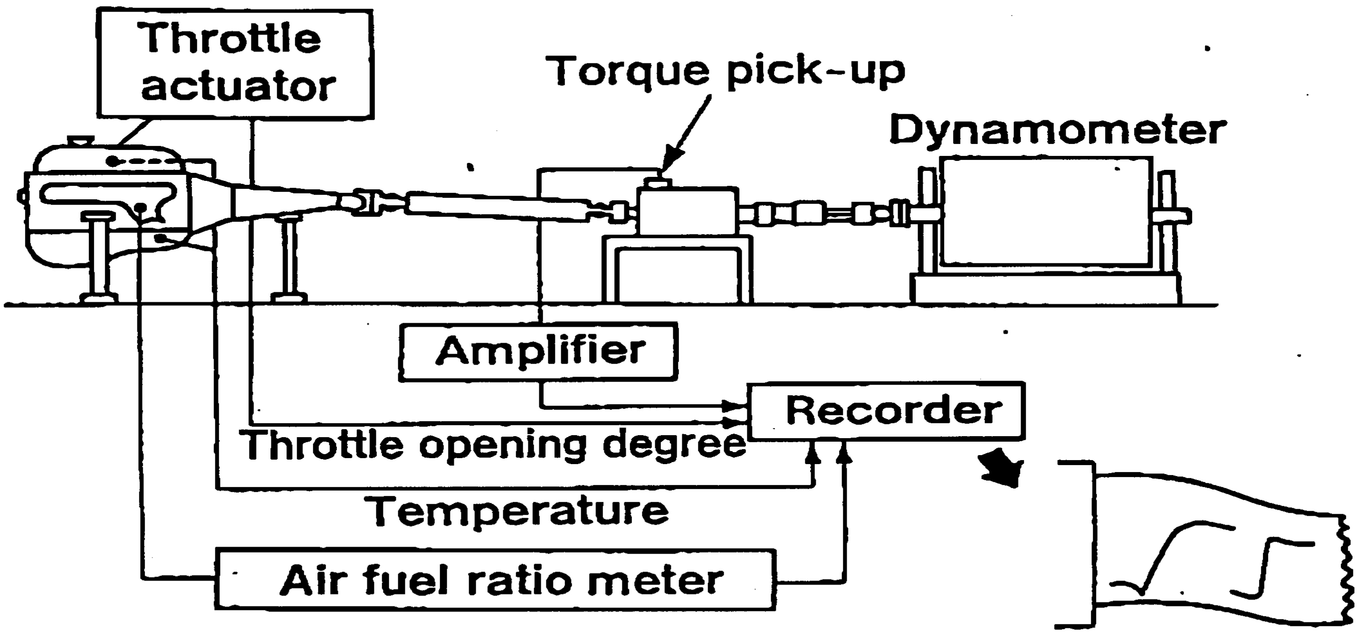


ATTACHMENT T2

1. Driveability Test
   * Hesitation during Warm-up Period
     - Engine Bench Test
       Engine Response Time
     - Vehicle Test --- Field Evaluation
   * Engine Startability Test
     - Low Temperature Test Cell --- 20° C, -25° C

2. Exhaust Emission Test
   Tailpipe Emissions, FTP

Study of the Effect
of
Gasoline Property
on
Engine Response

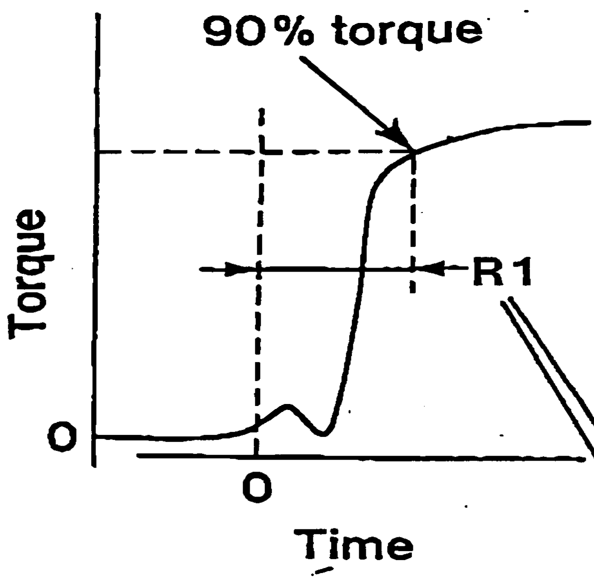


TOYOTA	Experimental apparatus	No. 5

Gasoline No.	1	2	3	----	10	11	12
RVP kPa	71.5	65.7	71.5	----	83.3	84.8	46.0
E70 %	32.3	27.8	32.9	----	33.4	35.7	20.5
T10 °C	48.0	50.5	47.0	----	42.0	41.0	59.5
T50 °C	91.5	99.0	91.0	----	100.0	94.0	110.0
T90 °C	152.0	159.0	152.0	----	162.5	163.0	161.0
Arom. %	28.5	28.0	38.5	----	47.0	38.0	32.8

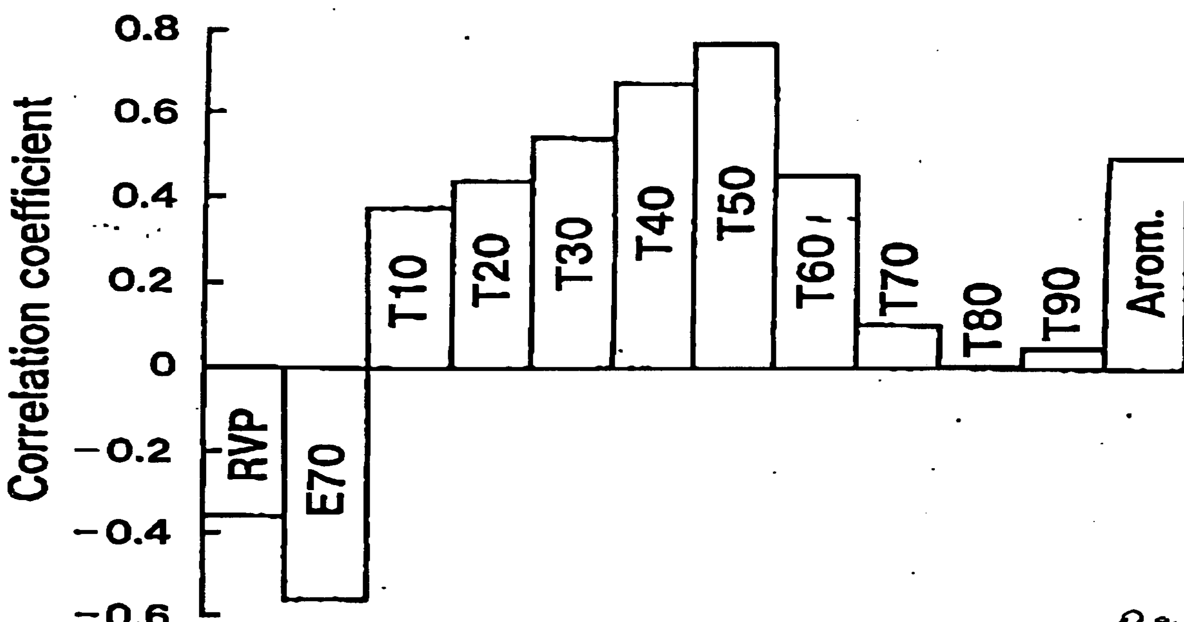
(no oxygenate)

TOYOTA	Test gasolines [page 3]	No. 8



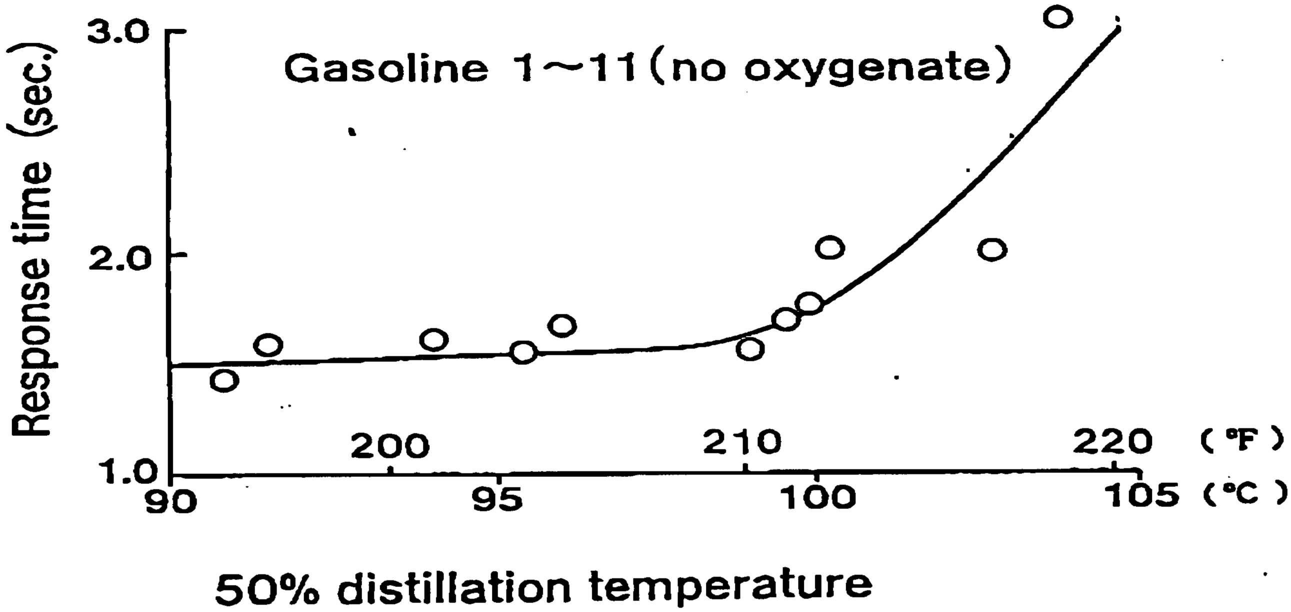
Gasoline	1	2
RVP kPa	71.5	65.7
E 70 %	32.3	27.8
T 10 °C	48.0	50.5
T 50 °C	91.5	99.0
T 90 °C	152.0	159.0
Arom. %	28.5	28.0
Response time (sec.)	R_1	R_2

TOYOTA	Response time and gasoline characteristics	No. 9

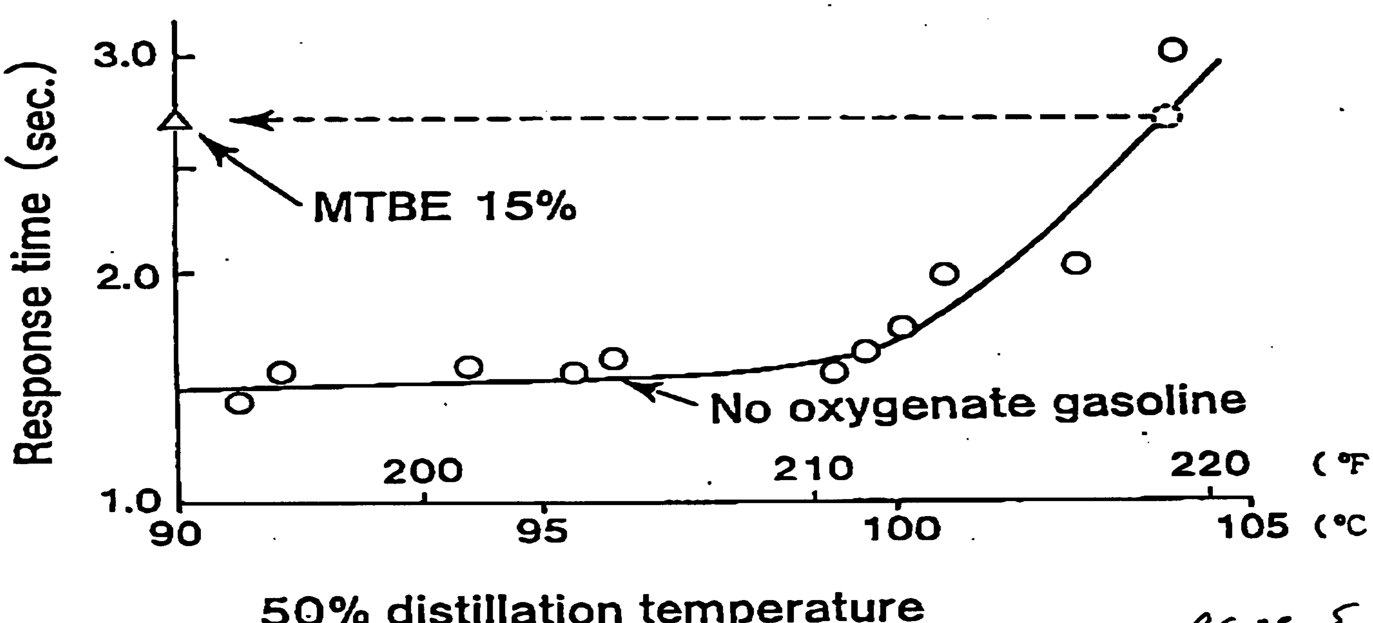


page 4

TOYOTA	Comparison of correlation	No. 10

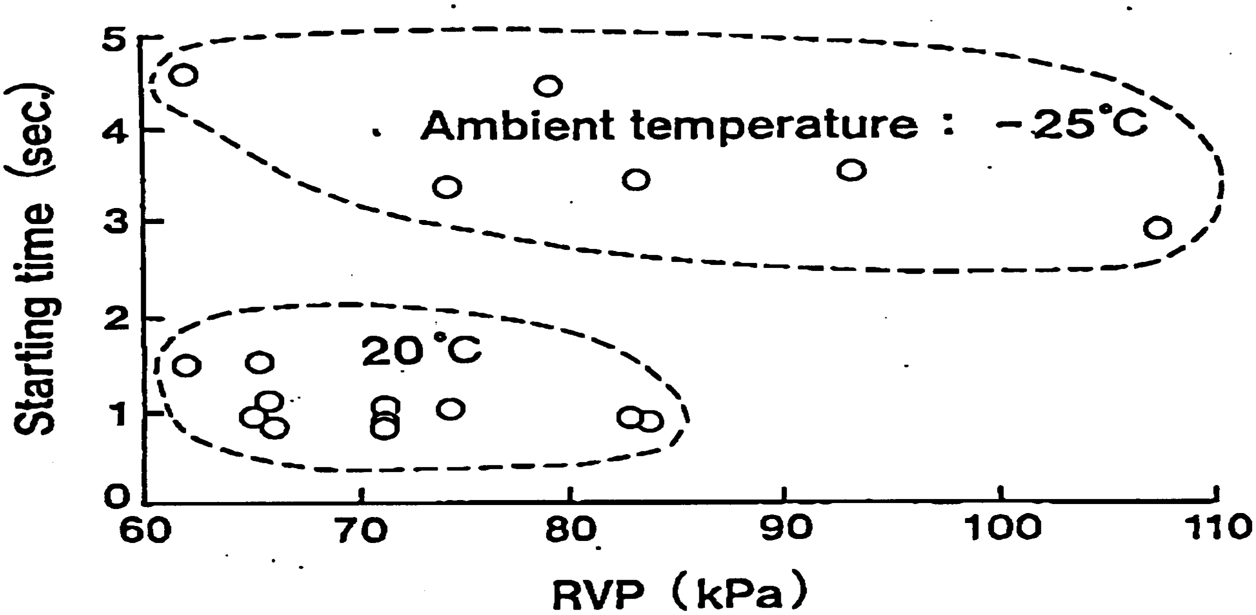


TOYOTA	Effect of 50% distillation temperature	No. 11



page 5

TOYOTA	Effect of MTBE blended gasoline	No. 20



TOYOTA	Effect of RVP on engine start	No. 14

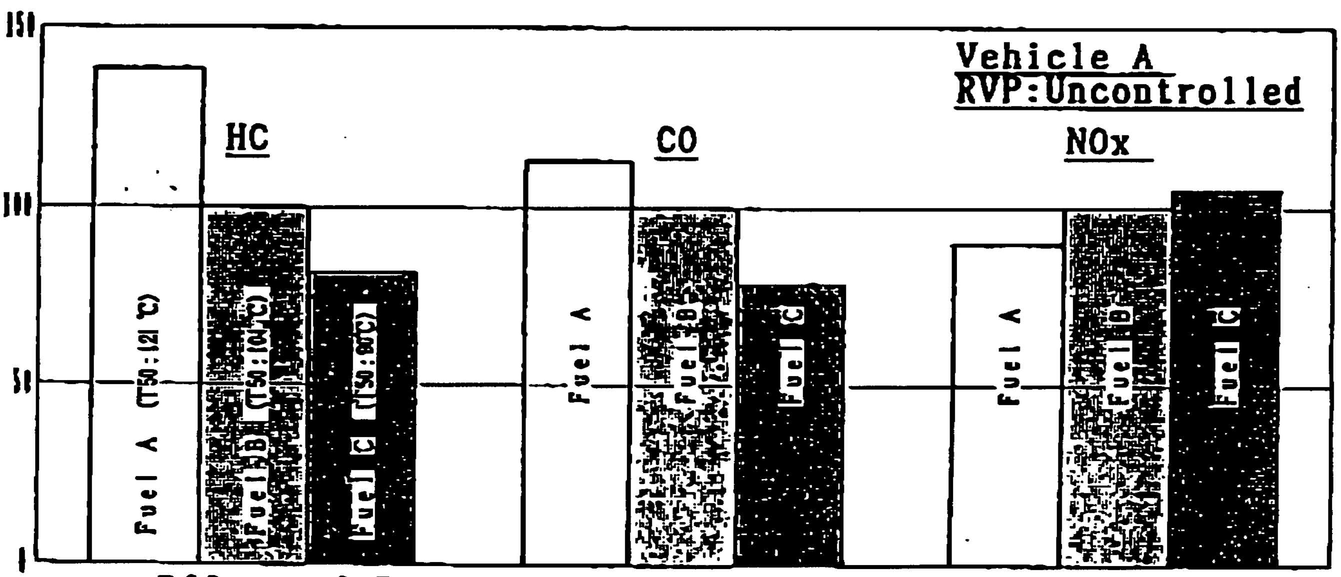
Results of Driveability Test

1. The Middle Range of Gasoline Distillation Temperature Strongly Affects Warm-up Driveability.
   T_{50} Can Be Used as One Indication of Warm-up Driveability.

2. RVP Has a Small Effect on Warm-up Driveability in the Range between 60~90 KPa (8.6~13.0 psi).

3. RVP Regulation Will not Deteriorate Vehicle Driveability, if T_{50} is controlled in a proper range.

Study of the Effect of Distillation Characteristics on Exhaust Emissions

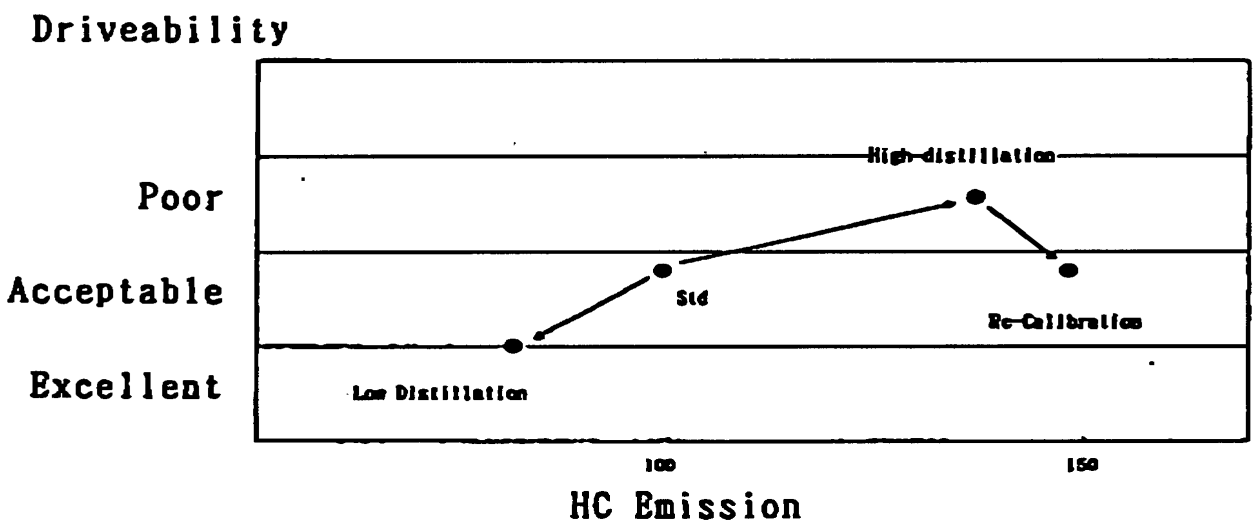


Effect of T_{50} on Exhaust Emissions (Fuel B=100)

page 7

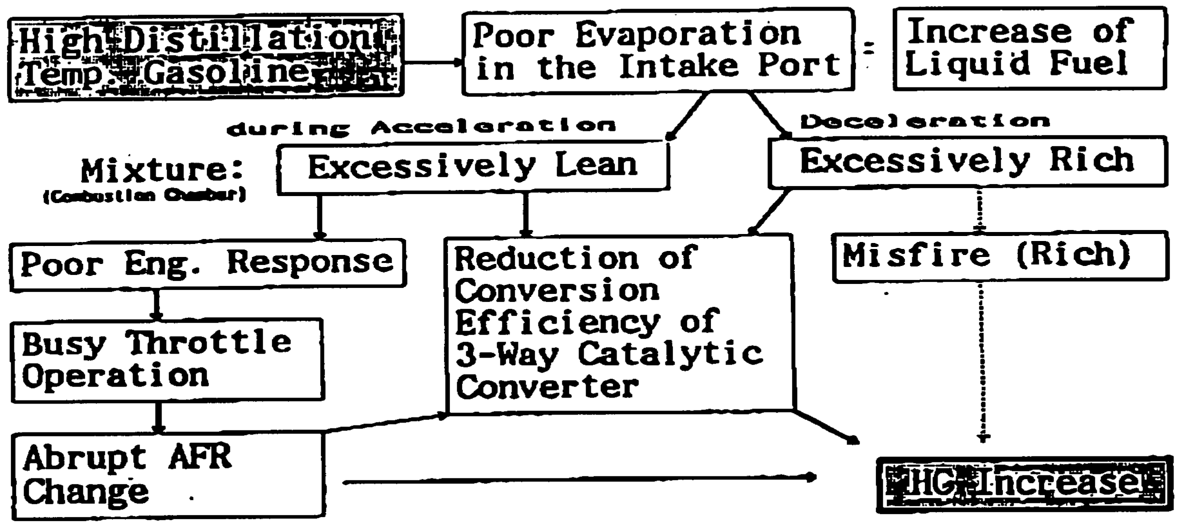
Comparison of Fuel Characteristics(A)

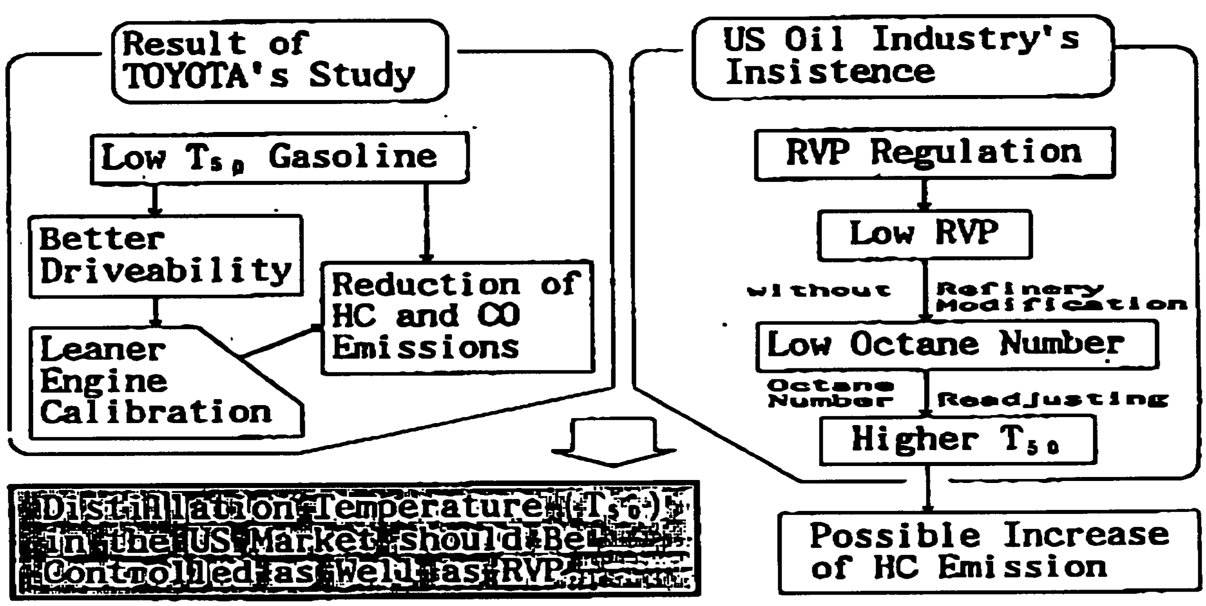
Fuel Characteristics		Fuel A	Fuel B	Fuel C
Density(g/mℓ@15°C)		0.766	0.743	0.734
RVP (kgf/cm²)		0.55	0.62	0.845
RON		97.2	91.5	91.4
MON		88.4	82.5	82.3
Distillation (°C)	IBP	34.5	31.5	27.5
	10%	58.5	53.0	43.0
	50%	121	104	90.0
	90%	170	157	161
	EP	209	176	176
Aromatics (vol%)		39.3	31.8	30.5
Olefins (vol%)		9.0	5.1	14.5



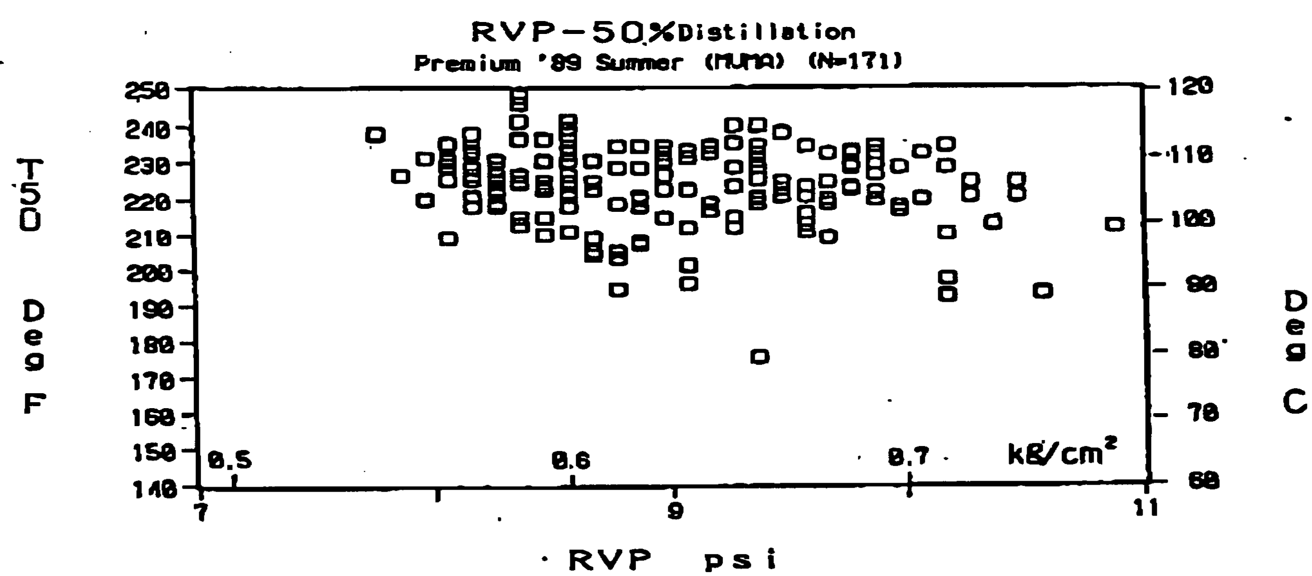
Effect of Gasoline Distillation Characteristics on Exhaust Emmission and Driveability

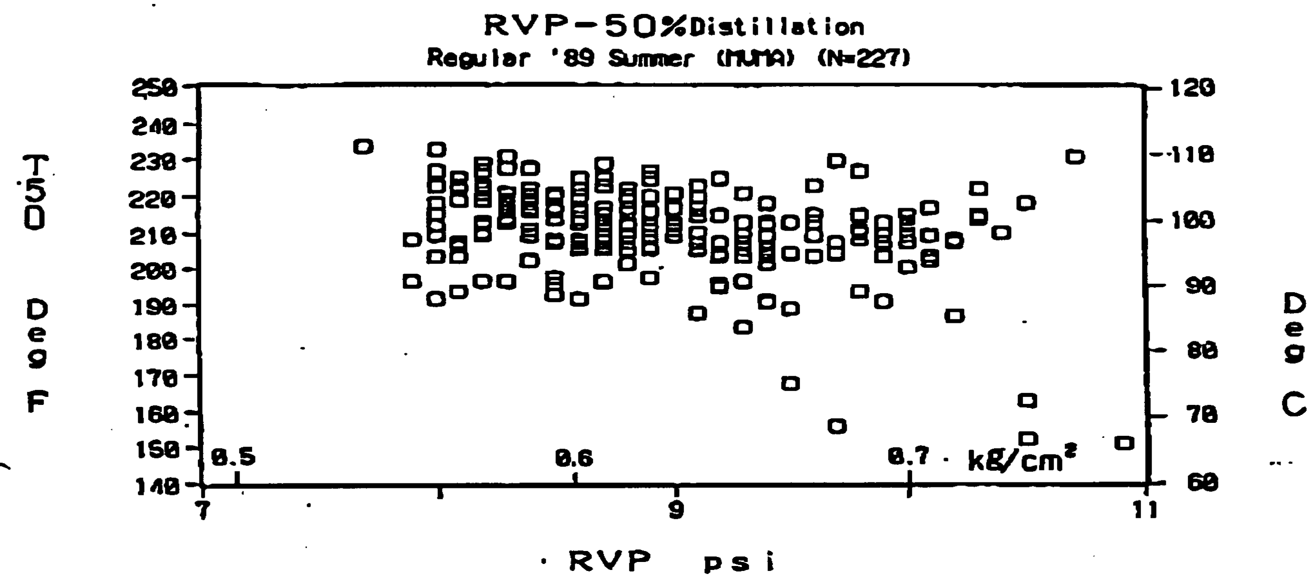
MECHANISM OF HC INCREASE WITH HIGH T_{50} GASOLINE

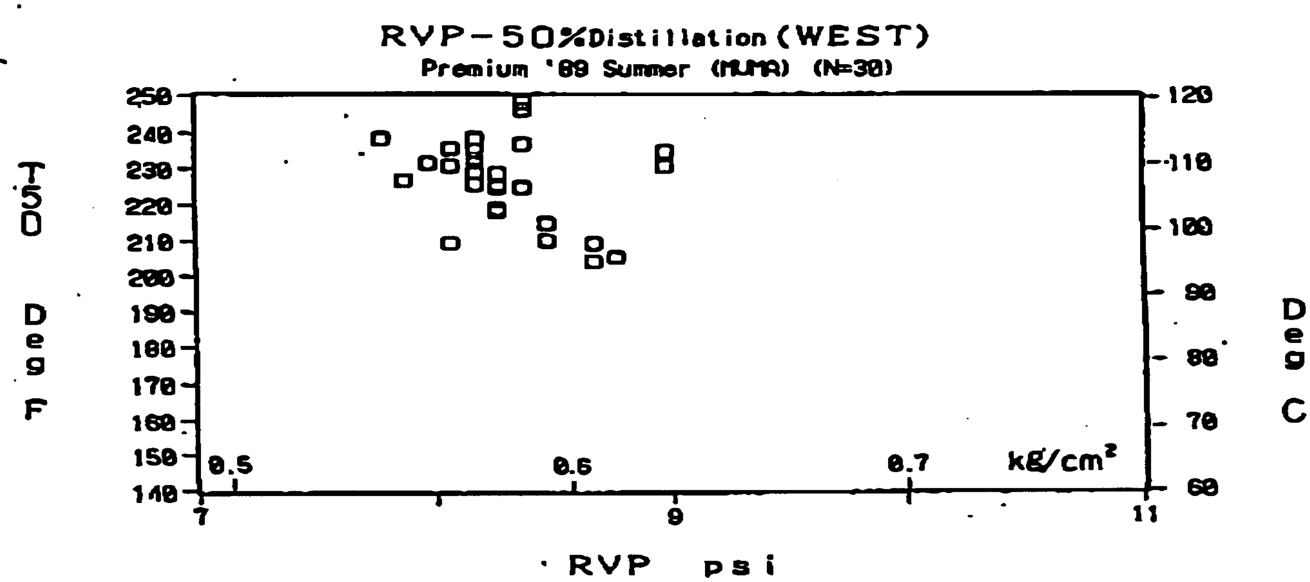




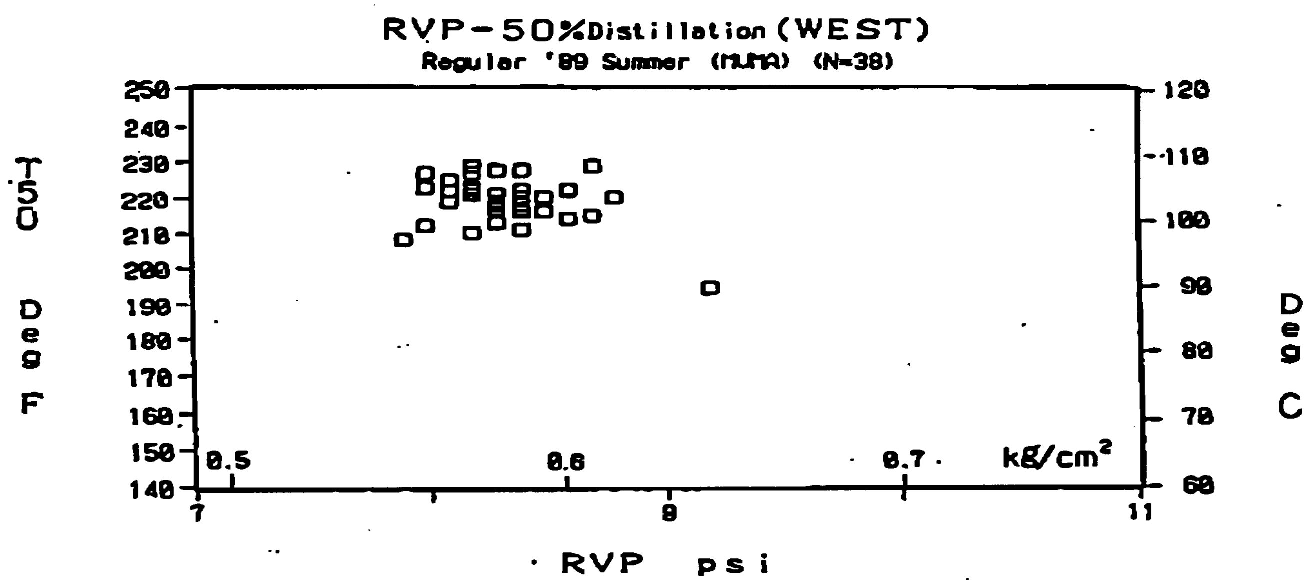
Distribution of Gasoline Characteristics in the US Market

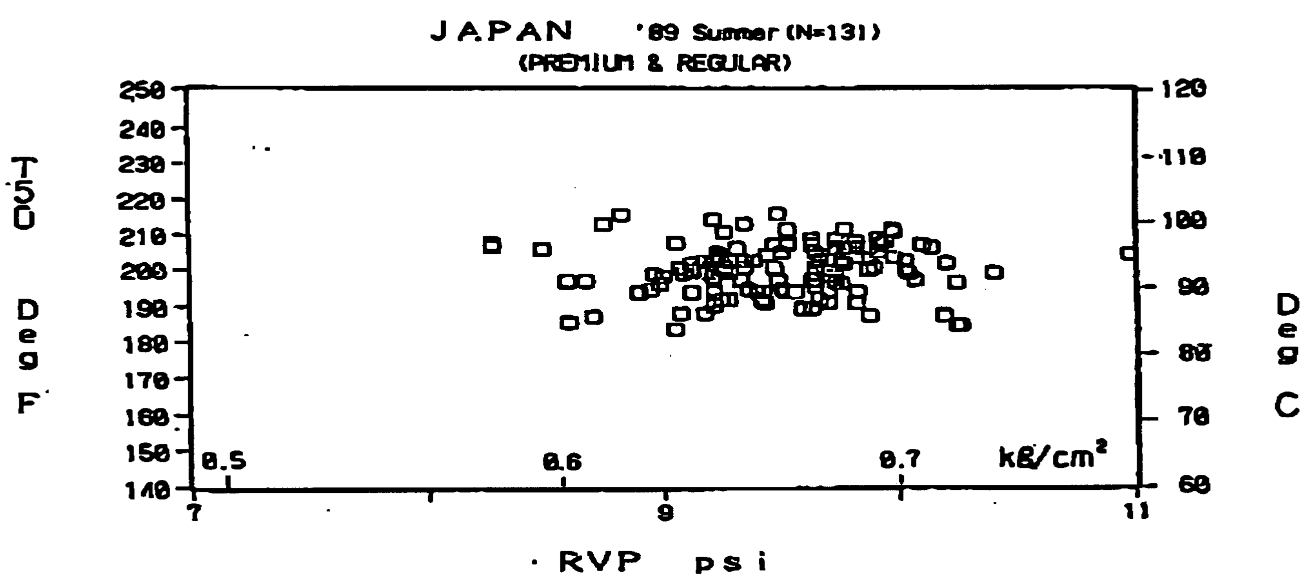



RVP-50%Distillation
Regular '89 Summer (MUMA) (N=227)
T50 Deg F
Deg C
RVP psi
kg/cm²
0.5
0.6
0.7
250
240
230
220
210
200
190
180
170
160
150
140
120
110
100
90
80
70
60
7
9
11


RVP-50%Distillation (WEST)
Premium '89 Summer (MUMA) (N=30)
T50 Deg F
Deg C
RVP psi
kg/cm²
0.5
0.6
0.7
250
240
230
220
210
200
190
180
170
160
150
140
120
110
100
90
80
70
60
7
9
11

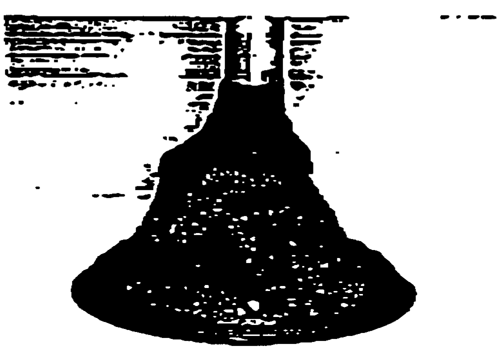
page 11


RVP-50%Distillation (WEST)
Regular '89 Summer (MVMA) (N=38)
T50
Deg F
Deg C
250
240
230
220
210
200
190
180
170
160
150
140
120
110
100
90
80
70
60
0.5
0.6
0.7
kg/cm²
7
9
11
RVP psi


JAPAN '89 Summer (N=131)
(PREMIUM & REGULAR)
T50
Deg F
Deg C
250
240
230
220
210
200
190
180
170
160
150
140
120
110
100
90
80
70
60
0.5
0.6
0.7
kg/cm²
7
9
11
RVP psi

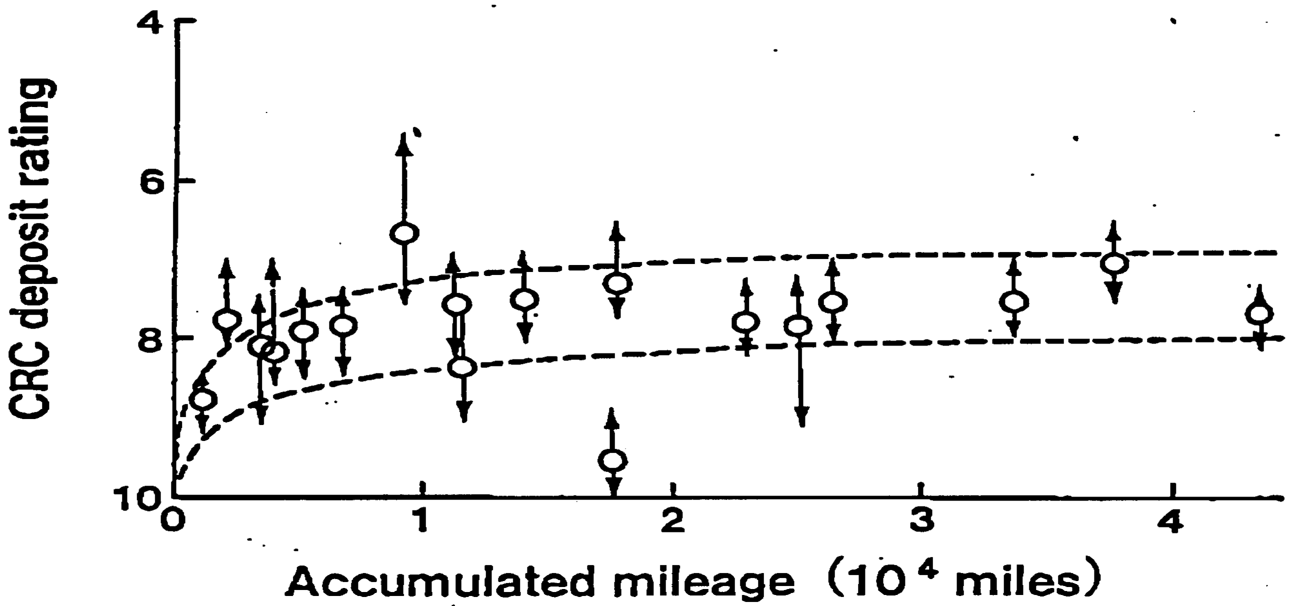
page 12

Study of the Effect
of
Intake Valve Deposit (IVD)
on
Exhaust Emissions and Driveability

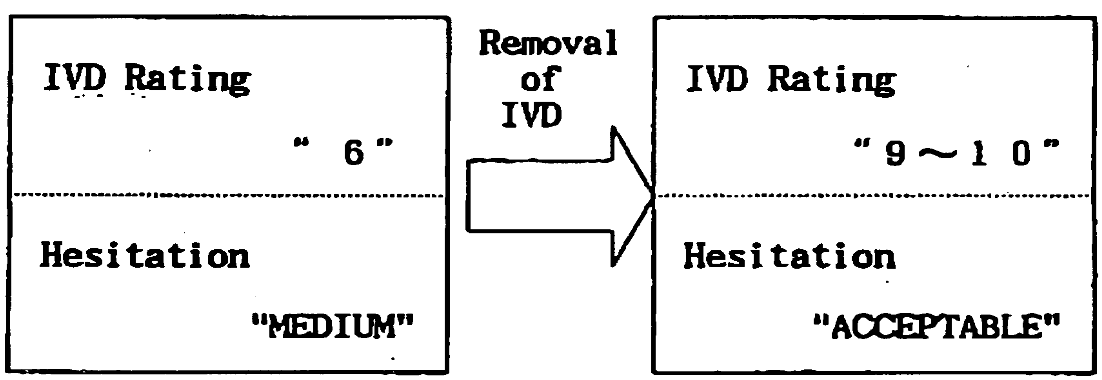


Test I

Test II



TOYOTA	IVD level in the US market	No. 26



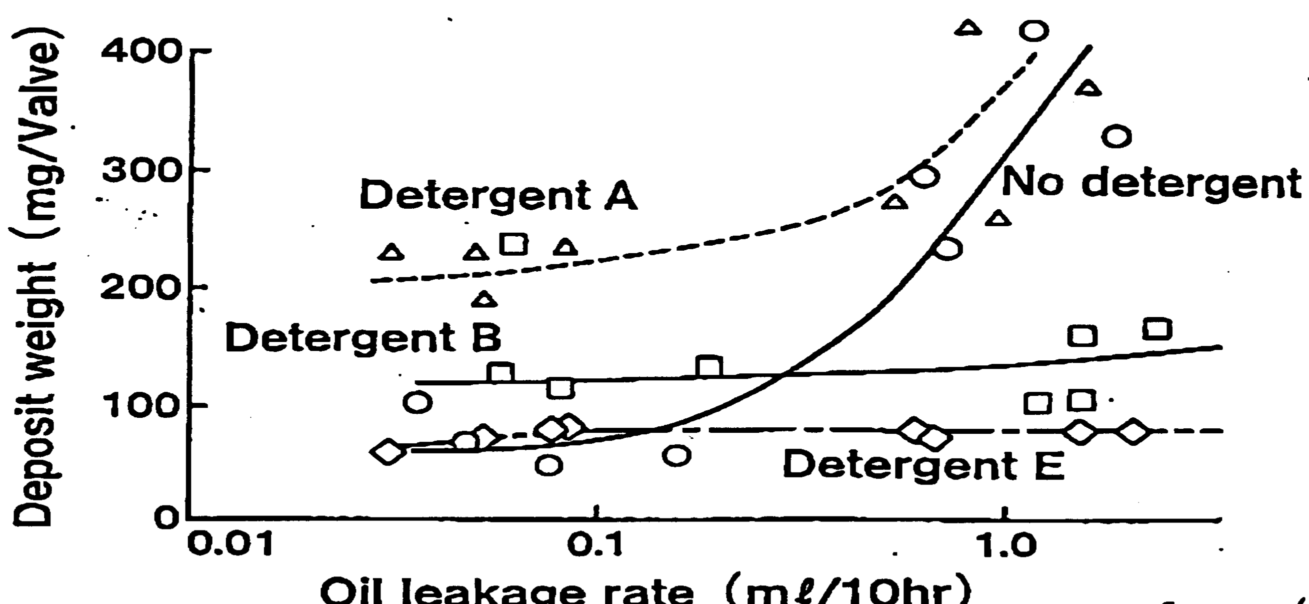
Effect of IVD on Vehicle Driveability

IVD Rating "6"	
HC	149
CO	101
NOx	127

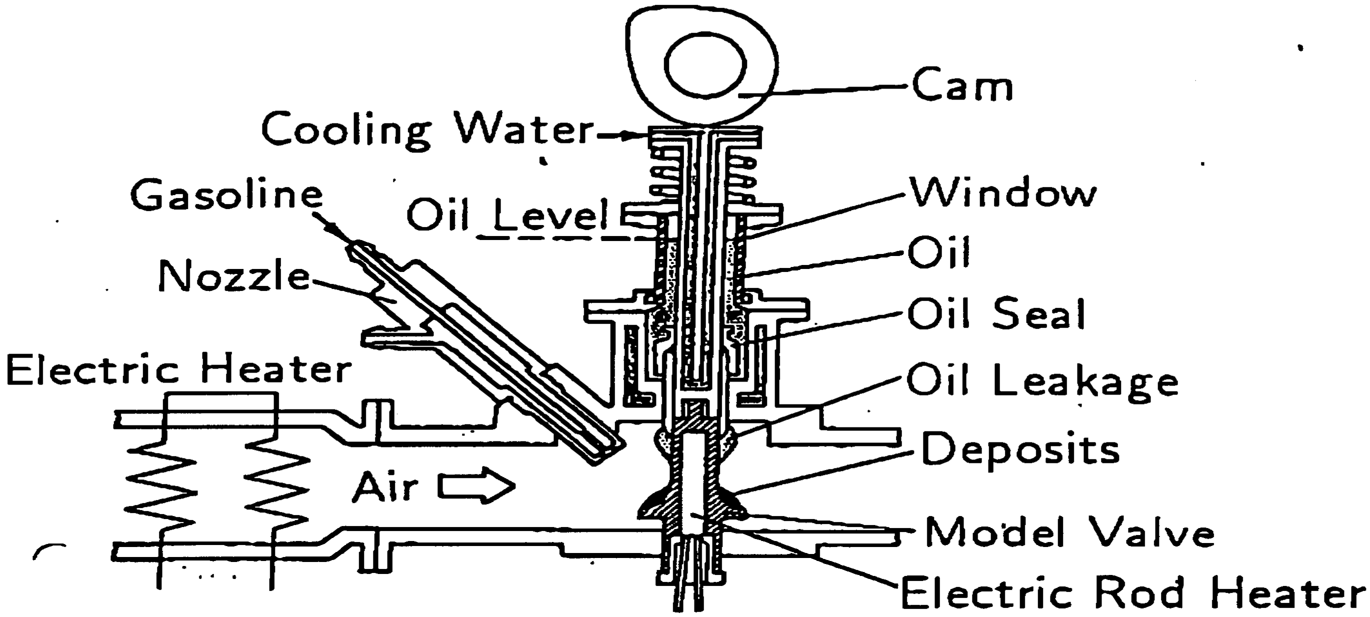
Removal of IVD →

IVD Rating "9～10"	
HC	100
CO	100
NOx	100

Effect of IVD on Exhaust Emissions



page 15



TOYOTA
C. R&D, INC.

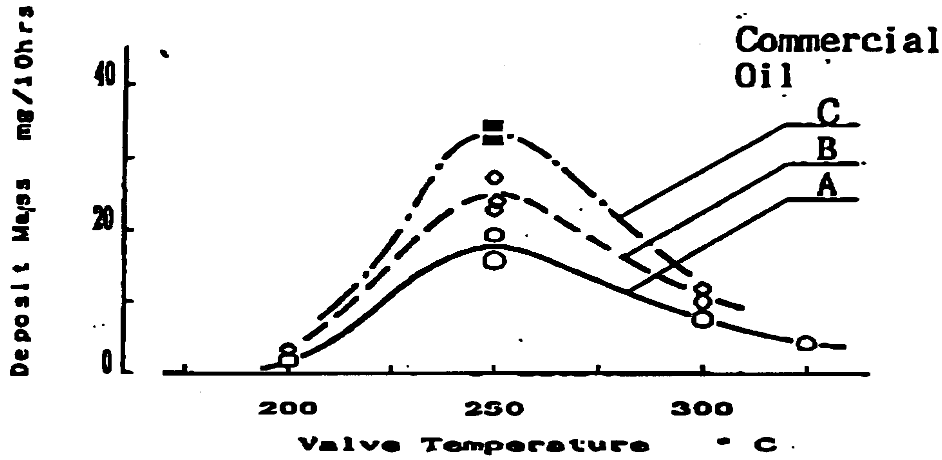
Structure of Simulator

Results of Our Study on the Intake Valve Deposit

(1) IVD Mainly Originates from Engine Oil.

(2) Poor Quality Gasoline Detergents Accelerate Oil Deterioration, and This Increases IVD Formation.

(3) Oil Quality Affects IVD Formation.
(See Next Slide)



Effect of Oil Quality on Intake Valve Deposit

CONCLUSION

(1) The middle Range of Gasoline Distillation Temperature affects Warm-up Driveability, and HC and CO Emissions.

(2) A T_{50} Decrease of 10- 15° C Produces 15-25 % Reduction of HC and CO Emissions.

(3) RVP Regulation may Encourage High T_{50} Gasoline in the US Market and result in Increased HC and CO Emissions, IF the Distillation Temperatures Are Not Controlled.

(4) It Is Hoped the Range of T_{50} Distribution in the US Will Be Reduced. This Will Contribute to Improved Air Quality.

(5) MTBE-Blended Gasoline Shows Poor Engine Response Characteristics Compared with HC-Type Gasolines.

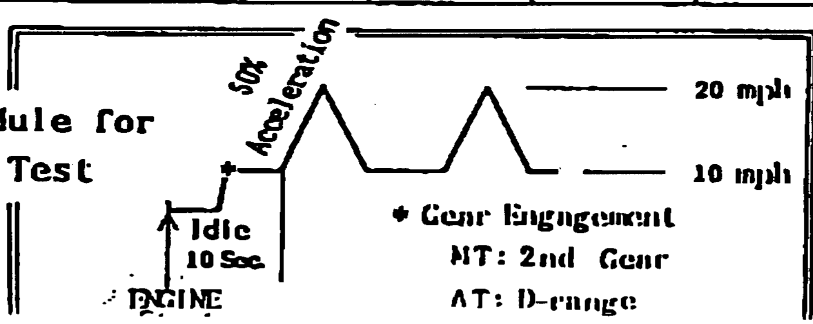
(6) IVD Deteriorates HC and CO Emissions. Engine Oil and Fuel Detergent Quality also Affect IVD.

Survey of Driveability of USA Cars

Test Vehicle

Model	Year	Engine	Displacement (l)	Fuel System	Trans-mission	Mileage
T_1	'87	L 4	2.0	F I	M T	1130
T_2	'89	L 6	3.0	F I	A T	3440
A	'87	V 6	3.8	F I	A T	898
B	'88	L 4	2.3	F I	A T	2830
C	'88	L 4	2.2	F I	M T	869
D	'88	V 6	2.7	F I	M T	3230

Driving Schedule for Driveability Test



page 1

Vehicle - Model	Gasoline T50 (℃)	Water* Temp (℃)	Test Cycle No. 1	2	3	4	5	Comment
T1	102	9						
	109	7						
		30						
	119	9						Back Fire
		30						Back Fire
T2	119	7						
A	109	17						Smoke
B	102	5						
		18						
	109	5						Back Fire
		30						
	119	9						Engine Stall
C	109	1						Back Fire
	119	5						
D	119	18						

* Water Temperature at Engine Start

Hesitation

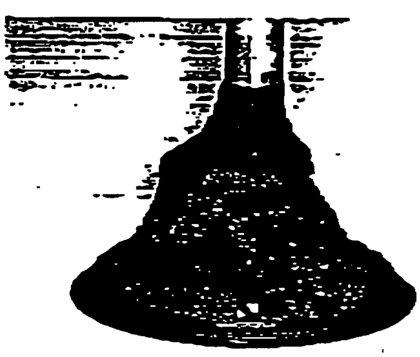
Heavy Moderato Trace None

Driveability Test Results

Summary of the Driveability Test

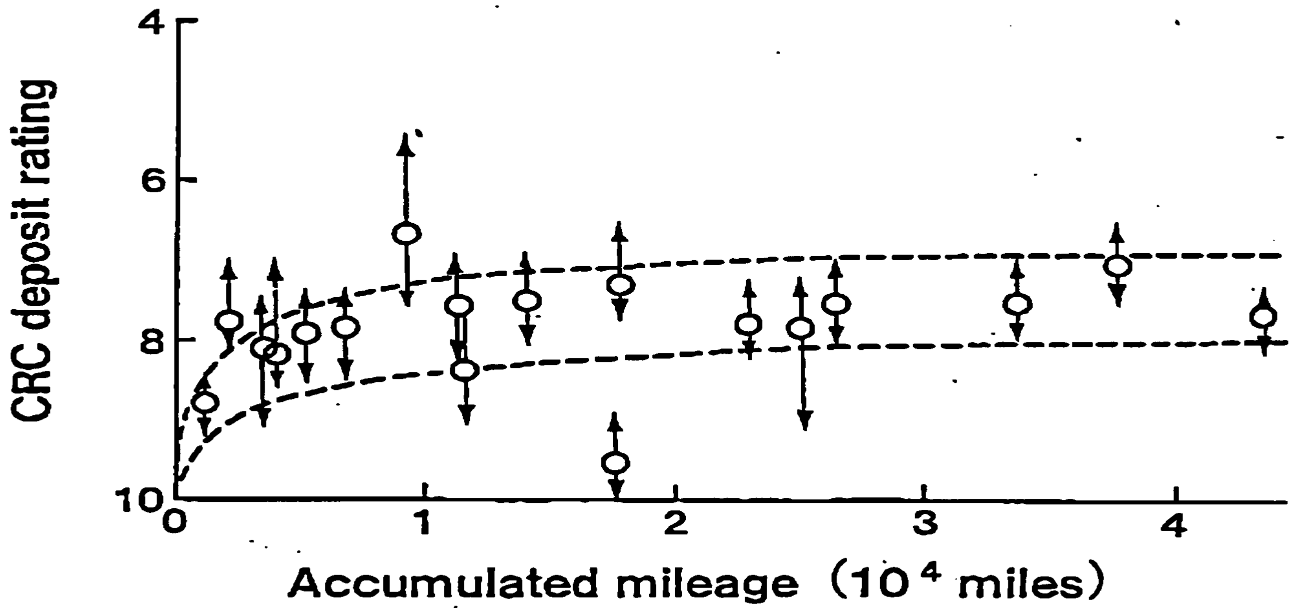
* We believe Customers in the USA Suffer Poor Driveability :
  - Caused by High Distillation Gasoline
  - Deteriorated by IVD Formation during warm-up Period
  - Particularly in the West Coast Area

Study of the Effect
of
Intake Valve Deposit (IVD)
on
Exhaust Emissions and Driveability

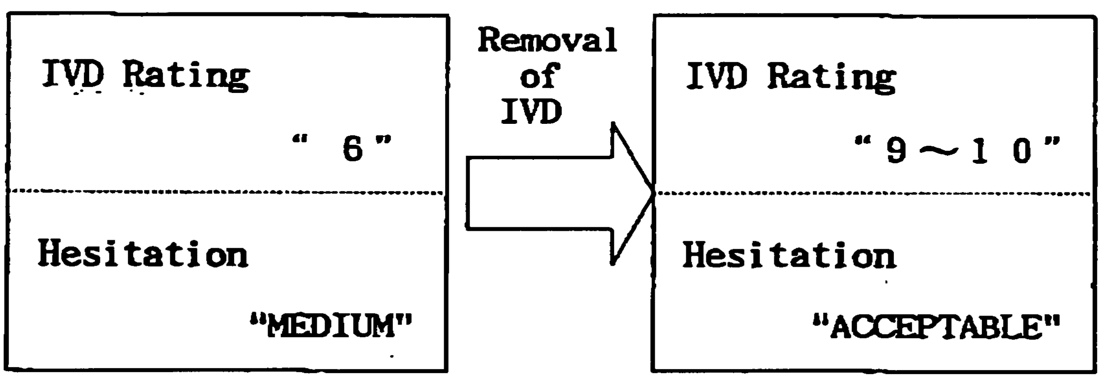


Test I

Test II



TOYOTA	IVD level in the US market	No. 26



Effect of IVD on Vehicle Driveability